Report for 2004IN164B: Septic System Permit Database

- Conference Proceedings:
  - Lee, B.D., D.P. Franzmeier, and P.J. Schoeneberger. Northeast Indiana moraine soils project. Indiana Assoc. Professional Soil Classifiers. January, 21, 2004. (56 participants)
  - Lee, B.D. Soils and septic systems. Indiana Environmental Health Association Spring Conference. April 30, 2004 (165 participants).
- Other Publications:
  -
- unclassified:
  -

Report Follows

Title: Mineralogy and hydraulic conductivity of selected moraines and associated till plains in NE Indiana

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Problem and Research Objectives:

One-third of Indiana residents utilize soil wastewater infiltration systems (septic systems), however, the Indiana State Department of Health (ISDH) estimates that 25% of these septic systems do not function properly. A 1997 survey of Indiana county health departments identified problematic soils as the most common reason for septic system failure. In 2001, the ISDH issued a memorandum stating that northeastern Indiana soils have caused premature septic system failure. The ISDH now requires 16 counties to conduct additional soil analyses before septic systems can be permitted.

Soils in northeastern Indiana and northwestern Ohio pose unique land use challenges due to poor drainage, high clay content, high shrink-swell capacity, and low hydraulic conductivity. A better understanding of the relationships between soil mineralogy, hydraulic conductivity, and soil physical properties is essential to the development of better soil-water management strategies.

Results from this study will assist northeastern Indiana county health departments in assessing soil conditions and developing a better understanding of the factors that contribute to septic system failure. The objectives of this study are to:

1. determine the soil hydraulic conductivity in major soils on the Bluffton Till Plain, NE Indiana

2. characterize the clay mineralogy in major soils of the Bluffton Till Plain

Methodology:

With the cooperation of the Natural Resources Conservation Service, twelve pedons were selected, sampled and described according to standard Natural Resource Conservation Service (NRCS) methods. Similar landscape positions were sampled at each site which are representative of the surrounding landscape. These sites form a transect through northeastern Indiana from Allen County to Hamilton County. At each pedon location, samples were collected for analysis at the National Soil Survey Center (NSSC), and at Purdue University. The samples sent to the NSSC will be fully characterized, with analysis including: particle size, total carbon, nitrogen, and sulfur; extractable bases, CEC, % base saturation, pH, percent carbonate as $CaCO_3$,

and clay mineralogy. We expect to receive the complete soil characterization data from the NSSC in late 2005.

The samples collected for Purdue will be used for clay mineral determination. These samples were fractionated into 3 size fractions: fine silt (2-5 μm), coarse clay (0.2-2 μm) and fine clay (<0.2 μm) by settling and centrifugation (Jackson, 1969). X-ray diffraction analysis and high resolution transmission electron microscopy coupled with octadecylalkylammonium techniques will be used to identify the clay minerals present in these samples.

Field saturated hydraulic conductivity (K_{sat}) measurements were collected with a constant compact head permeameter for selected horizons at each pedon location using a constant head permeameter. Saturated hydraulic conductivity measurements were collected in four depths, five replicates per depth.

Principal Findings:

Results listed below are based on data available at this time. Hydraulic conductivity data and soil morphology data are complete for the entire transect. Soil chemical data is available for 8 of 12 pedons at this time. We anticipate updating these results and completing the interpretations when the data set is complete.

Saturated hydraulic conductivity (k_{sat}):

In all but two of the pedon locations, the surface horizons had the highest hydraulic conductivity. Water could move through the surface horizon at least 2 fold faster than any other soil horizons analyzed. The Bt horizons show a dramatic decrease in hydraulic conductivity, due to the increased clay percentages and amount of fine clay. The Cd horizons in all of the pedons showed the slowest hydraulic conductivities. This horizon is quite compact at all of the sites, causing slow permeability of water through the soil.

Clay percentages:

Clay percentages in the Cd horizons (parent material) increased from around 15% in the southwest to 35% in the northeast. This is important because it shows that the parent material of these soils is not uniform across the transect.

Fine clay to total clay ratios:

The fine clay to total clay ratios for the Bt horizons show that fine clay makes up 33 to 47 percent of the total clay percentage. Because fine clays are more likely to be expandable and have a larger surface area, they can contribute to decreased soil hydraulic conductivity.

Depth to carbonates:

The depth to carbonates in 11 of the 12 pedons was less than 40 inches. This depth is limiting for installation of conventional septic systems in Indiana. The Indiana State Department of Health requires 42 inches of soil without carbonates for a conventional septic system to be installed at a site. This requirement would make nearly all of our sites unsuitable for conventional systems.

X-ray diffraction analysis:

The preliminary x-ray diffraction analysis supports the hypothesis that the fine clay fraction of the Bt horizons has a greater abundance of expandable 2:1 clay minerals. Clay mineral analysis is ongoing.

Significance:

This study has begun to characterize the physical and mineralogical properties of soils in northeastern Indiana. A better understanding of the relationships between soil mineralogy, hydraulic conductivity, and soil physical properties is essential to the development of better management strategies. Results from this study will assist northeastern Indiana county health departments in assessing soil conditions and developing a better understanding of the factors that contribute to septic system failure. With a better understanding of the soils, developers and installers as well as county health sanitarians will have a better idea of the types of systems that will work successfully in these areas, and reduce the need for expensive site specific soil tests. These results will be pertinent to current and future land use issues throughout northeastern Indiana, as the population grows and people continue to move into rural areas.

Our study results show that soils in northeastern Indiana have 15-35% clay in the Cd horizons with around 45% of this clay as fine clay. The fine clay fraction is dominated by expandable 2:1 clay minerals. Most of the pedons we sampled had carbonates between 38 and 66 cm from the surface. The carbonates indicate that very little water is being leached through the soil at this depth. The saturated hydraulic conductivity data supports this, as the values were much lower in these layers than in the horizons above them. Although the soils in northeastern Indiana are well suited for growing crops, they are not well suited for conventional onsite wastewater treatment systems (septic systems). Non-conventional septic systems may provide a better means of treating effluent in these soils.

Students Supported by IWRRC Funds

Jennifer L. Krenz, M.S. expected December 2005

Kelli S. Hart, M.S. expected March 2006

Abstracts

Hart, K.S., B.D. Lee, P.J. Schoeneberger and D.P. Franzmeier. 2005. Hydraulic conductivity across a toposequence on the Wabash moraine, northeast Indiana. *In* Agronomy abstracts, ASA, Madison, WI.

Krenz, J.L., B.D. Lee, D.G. Schulze, P.J. Schoeneberger, D.P. Franzmeier, S.K. Sears, and H. Vali. 2005. Illitic soil mineralogy: Bluffton Till Plain and associated moraines in northeast Indiana. *In* Agronomy abstracts, ASA, Madison, WI.

Presentations

Lee, B.D., D.P. Franzmeier, and P.J. Schoeneberger. Northeast Indiana moraine soils project. Indiana Assoc. Professional Soil Classifiers. January, 21, 2004. (56 participants)

Lee, B.D. Soils and septic systems. Indiana Environmental Health Association Spring Conference. April 30, 2004 (165 participants).

Krenz, J.A., B.D. Lee, D.P. Franzmeier, P.A. Schoeneberger and K.S. Hart. Soil properties of the moraines and associated till plains in NE Indiana. Indiana Association of Professional Soil Classifiers Winter Conference, Jan. 26, 2005. Indianapolis, IN. (85 participants)

Publications

Hart, K.S., B.D. Lee, P.J. Schoeneberger, and J. Krenz. 2005. Soil hydraulic conductivity on the Wabash Moraine, Wells County, IN. Purdue Cooperative Extension, RW-2 (*in review*).

Grants Leveraged with IWRRC Funds

Recessional moraine soil hydraulic conductivity investigation: Northeastern Indiana. Indiana State Department of Health, Center for Disease Control Preventative Health and Health Services Block Grant Program. 2004. Brad D. Lee, PI ($26,999)

Northeastern Indiana soil chemical and physical properties involved in premature septic system failure. Indiana State Department of Health, Center for Disease Control Preventative Health and Health Services Block Grant Program. 2005. Brad D. Lee, PI ($19,160)

Mineralogy of the moraines and associated till plains in northeastern Indiana. Geological Society of America, Graduate Student Research Grant. 2005. Jennifer A. Krenz, PI ($1500)